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A COMMENT ON THE ZONAL, INTRAZONAL, AND AZONAL CONCEPTS AND SERPENTINE SOILS

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Some prominent ecologists have stated that serpentine soils (soils with ultramafic parent materials) are azonal. Actually, only a small percentage of the serpentine soils are azonal. In order to rectify the inappropriate characterization of serpentine soils as azonal, it is helpful to review the origin and application of the zonal, intrazonal, and azonal terms in soil classification.

A soil classification system based on the zonal, intrazonal, and azonal concepts was first developed by Sibirtzev in Russia (Glinka 1914). These concepts were subsequently utilized in the USA (Marbut 1927). Then they were abandoned in the precursor to the present Soil Taxonomy of the USDA (Soil Survey Staff 1960), because the zonal concepts are too "arbitrary" to apply objectively and consistently (Kellogg 1963).

Zonal soils are those that reflect the influence of the regional climate. Very shallow soils and soils in recent alluvium, volcanic ash, eolian sand, or loess that lack significant pedological development are azonal soils. They are those rudimentary soils that in similar deposits are similar in all climatic regions (or zones), ignoring vegetative differences. Intrazonal soils are those that reflect the influence of local conditions such as poor soil drainage that make the soils different from the "normal" zonal soils.

A major problem with these concepts is deciding what is *normal.* Is it a 10,000 yr old soil in glacial drift or is it a 100,000 yr old soil on basalt, granite, or serpentinized peridotite? The decision might depend on the common lithology in a region, but the soils in a region with predominantly one of these parent materials (for example, granite) might be quite different from the soils in a climatically similar region with different parent materials (for example, basalt). In fact, well drained and developed serpentine soils (those other than Entisols) might be considered zonal soils in a region where the lithology is predominantly ultramafic rocks.

Most serpentine soils in the botanical California Region are Alfisols, Mollisols, and Inceptisols (Alexander et al. 2007). Only Entisols might definitely be called azonal soils, and Entisols occupy only about 0.8% of the serpentine area in the Region (Alexander 2004). Therefore most of the serpentine soils are either zonal or intrazonal, depending upon how one applies these concepts. Those who consider ultramafic rocks to be unusual components of the continental crust would assume that most serpentine soils are intrazonal.

The zonal-intrazonal-azonal concepts are very useful, even though they are insufficiently definitive to use in a modern system of soil classification. The zonal and intrazonal concepts can be applied to plant associations as well as to soils. Zonal plant associations may be common on zonal soils and intrazonal plant associations may be common on intrazonal soils. The azonal concept, however, is not easily applied to plant communities. Perhaps the plant associations that conform most closely to the azonal concept are those in early stages of succession. Some plant species, such as *Bryum argenteum* Hedwig and *Achillea millefolium* L., have the azonal characteristics of being widespread across many climatic zones, but the azonal concept may not be applicable to plant associations.

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